



Lakeview Rock Products, Inc.

0005

M/035/0020
TASK 3294
CCL CES/LD

P.O. Box 540700

900 North Redwood Road
North Salt Lake, Utah 84054-0700
(801) 292-7161

December 14, 2009

Mr. Paul B. Baker
Minerals Program Manager
Department of Natural Resources
State of Utah
Division of Oil Gas and Mining
P.O. Box 145801
Salt Lake City, UT 84114-5801

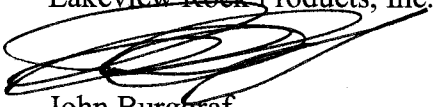
**Subject: 2009 Slope Stability Analysis - Lakeview Rock Products Inc., Beck
Street Quarry, M0350020, Salt Lake & Davis Counties, Utah**

Dear Mr. Baker:

Attached please find the updated Slope Stability study performed by Geostrata in November of 2009 for the Beck Street Quarry. This study is being submitted to satisfy the requirements outlined in Section 6.4.1 of the NOI.

Please feel free to give me a call if you have any questions. Additionally, please note the proper spelling of the undersigned.

Sincerely,
Lakeview Rock Products, Inc.



John Burggraf
Vice-President

cc: Scott G. Hughes – Vice President, LRP
Kevin Watkins – General Counsel, LRP

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DEC 16 2009
DIV OF OIL, GAS & MINING

0005

November 30, 2009

Mr. John Burggraf
Lakeview Rock Products
900 North Redwood Road
North Salt Lake, UT 84054

GeoStrata Project No. 609-001

**RE: Lakeview Reclamation Pit Slope Stability
North Salt Lake City, Utah**

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Mr. Burggraf,

This letter report presents the results of our slope stability assessment for the Lakeview Pit, Beck Street Quarry located in North Salt Lake City, Utah. Our scope of work performed was in accordance with our original proposal dated April 7, 2009. The work scope included a review of previous reports and maps, a field mapping investigation, an engineering analysis of the data gathered and the preparation of this letter report. As we understand, the purpose for the work is to update the slope stability work that was performed by Intermountain GeoEnvironmental Services (Intermountain) in 2004 and assess whether conditions are similar to the original analysis approved by the Division of Oil Gas and Mining (DOGM). The project site is shown on Plate A-1, the Site Vicinity Map.

Field work

Field work was conducted on November 4, 2009. The field work consisted of two engineering geologists measuring the orientation of bedding planes and fractures throughout the site, assessing the GSI values, recording Schmidt hammer readings, and recording geologic hammer blow data. Bedding data was used to constrain our geologic cross section and the material strength data was input into the software program RocLab. Data was gathered at the lower and upper pits as we did not have access to the middle pit during our site visit.

Geology overview

The geology of the pit area is fairly complex and is a significant factor in modeling the slope stability of the Lakeview Pit. Plate A-2 shows the geology of the area as mapped by Bryant (1990). The pit mines through units at the base of the lower pit which are Paleozoic age (540-250 ma) and Cenozoic age (65 ma to present) in the middle and upper pits. The contact between these two units is an unconformity which is consistent with geologic maps of the area (Bryant, 1990, Hintze, 1988). The Cenozoic strata in the area are often bent into subtle folds with wavelengths off 0.5 miles (Bryant, 1990).

Cross section

GeoStrata constructed two east-west trending cross sections (see Plates D-1, D-2) a northern cross section and a southern cross section. The locations of each section are shown on Plate A-3.

To construct the cross sections (see Plate D-1, D-2) GeoStrata utilized bedding plane measurements from the geologic map for the area (Bryant, 1990), and data collected during our field work. GeoStrata did not have access to any of the boring data that was done in previous reports. Bedding data for the conglomerate of the upper pit was difficult to ascertain during our field work since the unit is largely massive. Measurements for this unit were extracted from Bryants' (1990) geologic map of the area. The rocks of the lower pit are mapped (Bryant, 1990) as the Cambrian age Maxfield limestone (Cm). GeoStrata reviewed the airphotos of the area and the upper part of the Maxfield limestone appears to be thinly bedded and perhaps more silty than the lower section. This contact is in the area of the middle pit which GeoStrata was not able to access. The upper member of the Maxfield limestone is mapped in both cross sections as Cm1 (Plates D-1, D-2). As stated previously, the contact between the Cm1 and the Tertiary age Wasatch conglomerate found in the upper pit is unconformable.

Indices

As previously stated, GeoStrata used the software program RocLab to derive the strength parameters to be used in the model. This software uses several indices to derive a mohr coulomb strength envelope for the bedrock. As previously identified, three distinct bedrock types were mapped in the gravel pit. They consisted of the underlying Maxfield limestone which transitioned into a siltstone near the top of the formation. Unconformably overlying the siltstone was the Wasatch conglomerate. The Maxfield limestone covers the majority of the area in the lower pit area and the Wasatch conglomerate generally exists in the upper pit area. The indices used in the program include σ_{ci} (sigci), GSI, mi, D and MR.

Sigci is defined as the uniaxial compressive strength. We used two methodologies to define the sigci value to be used in the program. They included the use of a Schmidt hammer and rock hammer blows to define the intact rock strength. More than 113 Schmidt hammer readings were taken in the lower pit area and 53 reading were taken in the upper pit area. The lower pit had values that ranged from a low of 0 to a high of 5900 psi. Using these values in our assessment, the average Schmidt hammer readings for the lower pit was 1452 psi. The upper pit had Schmidt hammer values that ranged from a low of 0 to a high of nearly 7100 psi. The average Schmidt hammer reading for the upper pit was nearly 3600 psi.

Rock hammer blows were only taken in the lower pit area. This methodology is defined by Hoek-Brown (2002). The range of blows to fracture the rock ranged from 1 to a high of 5 to 6 blows. Using the methodology noted, we estimate the average rock strength from this method to be approximately 6700 psi. Using all of the information obtained, we assigned a sigci value of 7 ksi for the limestone and a sigci value of 8 ksi for the conglomerate.

The GSI index (Hoek and Marinos, 2000) is a technique used to estimate the average strength value of a given rock. During field work at the Lakeview pit GSI values were assessed in a systematic fashion by breaking the lower and upper pits into a grid. Each cell of the grid was then assigned a GSI value.

To asses a GSI value of a given area, the structure and the surface conditions of the rock are classified. There are 6 categories of structure for a rock ranging from intact to sheared.

Additionally, there are 5 categories of surface conditions ranging from very good to very poor. GeoStrata found GSI values ranging from the upper 40's to the upper 60's during our field work. We assigned GSI values of 45 to 50 for the rock encountered in the pit areas. Actual values used are presented on Plates B-14 through B-16.

The remaining indices used in the program offer ranges for the various values. We elected to use the lowest range of the values given. As previously noted, no readings or observations could be made on the siltstone since access to the middle pit area was not available at the time of our field investigation. Since the siltstone is still considered a part of the Maxfield limestone, we applied similar but lower values to the siltstone than those applied to the limestone.

Once all of the parameters were entered, the following values were obtained from the RocLab program;

Rock Type	Unit Weight (pcf)	Phi Angle (degrees)	Cohesion (psf)
Limestone	155	39	6300
Siltstone	150	37	5800
Conglomerate	145	45	7900

Results for the RocLab work is presented in Appendix C and Plates C-1 through C-3. We lowered the conglomerate phi angle from a calculated 47 degrees to 45 degrees. These values are generally greater than the original values used in the slope stability modeling by Intermountain, particularly, the siltstone strength value. We were not able to assess the intact rock strength based on access issues. However, it is our opinion that since the siltstone is likely the upper member of the underlying Maxfield limestone, we assigned values that were similar to the limestone, although somewhat lower to account for the material change.

Engineering Analysis

An original slope stability assessment was performed by Intermountain GeoEnvironmental Services dated January 7, 2004. Our model differs from their original model in several areas. Based on our site visit, the upper conglomerate appears to be more competent than they originally assess. It is our opinion that less joints and fracturing appear in the conglomerate than the underlying limestone.

It appears that operationally, the pits are generally following the original recommendations provided in the Intermountain report and the slopes appear to be performing satisfactorily. Our analysis used the slope recommendations provided by IGES and the strength parameters that we obtained from our field observations. Two cross sections were generated from the most recent topography. The location of the two sections are based on our analysis, the slope provides a larger factor of safety than that originally derived. An overall global factor of safety of 1.43 was obtained for the northern cross section and a factor of safety of 1.57 was obtained for the south cross section. We further analyzed both the lower and upper portions of the slope. Higher factors of safety were obtained for both of these conditions considered. Plates B-1 through B-12 present the results of the slope stability analysis performed on the slopes.

During the original modeling a phi angle of 12^0 was used by IGES for the siltstone layer. We feel that this value is much too conservative and likely not realistic. However, since we could not access the middle pit area where this layer is located, we modeled the slope with a similar lower value. Results of this modeling gave us a factor of safety for the northern cross section of 1.32 which is very similar to the results obtained by IGES.

Finally, based on the dip of the limestone it should be anticipated that the height of the limestone layer in the pit will decrease as the pit migrates further and further into the hillside. This will require that the 60 degree portion of the pit will become smaller and smaller with time. Based on our observations of the overlying conglomerate member, it is our opinion that the steeper slopes can likely be constructed in this member than those originally proposed. We would however recommend that benches be created as a part of the as constructed slopes. The benches should have a maximum height of 80 to 100 feet and a width of 25 feet.

As an additional part of our engineering assessment, we performed a block failure analysis of the existing mine walls. This analysis considers fractures/joints and bedding planes within the bedrock, the slope of the excavation walls, and the rock strength in order to analyze the risk of large blocks of bedrock sliding out of the excavation face. Fracture mapping performed by GeoStrata indicated that the upper conglomerate has no significant fracture sets. The lower limestone and siltstone has two major fracture sets; one with a strike of 180 degrees and a dip of 70 and the other with a strike of 130 degrees and a dip of 75. The bedding of the limestone has a strike of 13 degrees and a dip of 35 degrees. The existing wall face trends primarily north to south with three terraces in the lower limestone. The terraces have a strike of 165 degrees and dips of 60, 56, and 45. Our block failure analysis indicates that the excavation walls as configured do not have fracture sets within the bedrock which produce blocks with a high risk of sliding. It should be understood that changes in the wall facing can significantly change the risk of block failures. GeoStrata should be consulted before these changes are made so that appropriate analyses can be made.

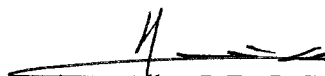
Limitations

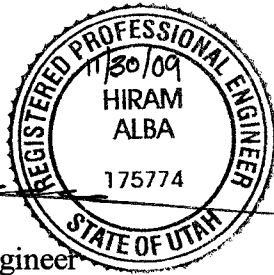
We appreciate the opportunity to provide you with our services. Our work is based on a limited field exploration and changes in jointing, material types and strengths will likely vary as the excavation continues. GeoStrata should be contacted if changes in the material and/or other concerns arise during the excavation of the pit. All work was completed in accordance with the current standard of care, no warranty expressed or implied is provided. No subsurface explorations were completed nor were laboratory tests performed as a part of our scope of work. If you would like to discuss any of the issues contained in this letter in more detail or have additional questions please contact us at your convenience (801) 501-0583.

Ω

We appreciate the opportunity to provide these services. Please contact us if you have questions regarding the information provided in this letter.

Respectfully,
GeoStrata, LLC


Hiram Alba, P.E., P.G.
Senior Geotechnical Engineer



Reviewed by,



Mark Christensen, PE
Senior Geotechnical Engineer

REFERENCES

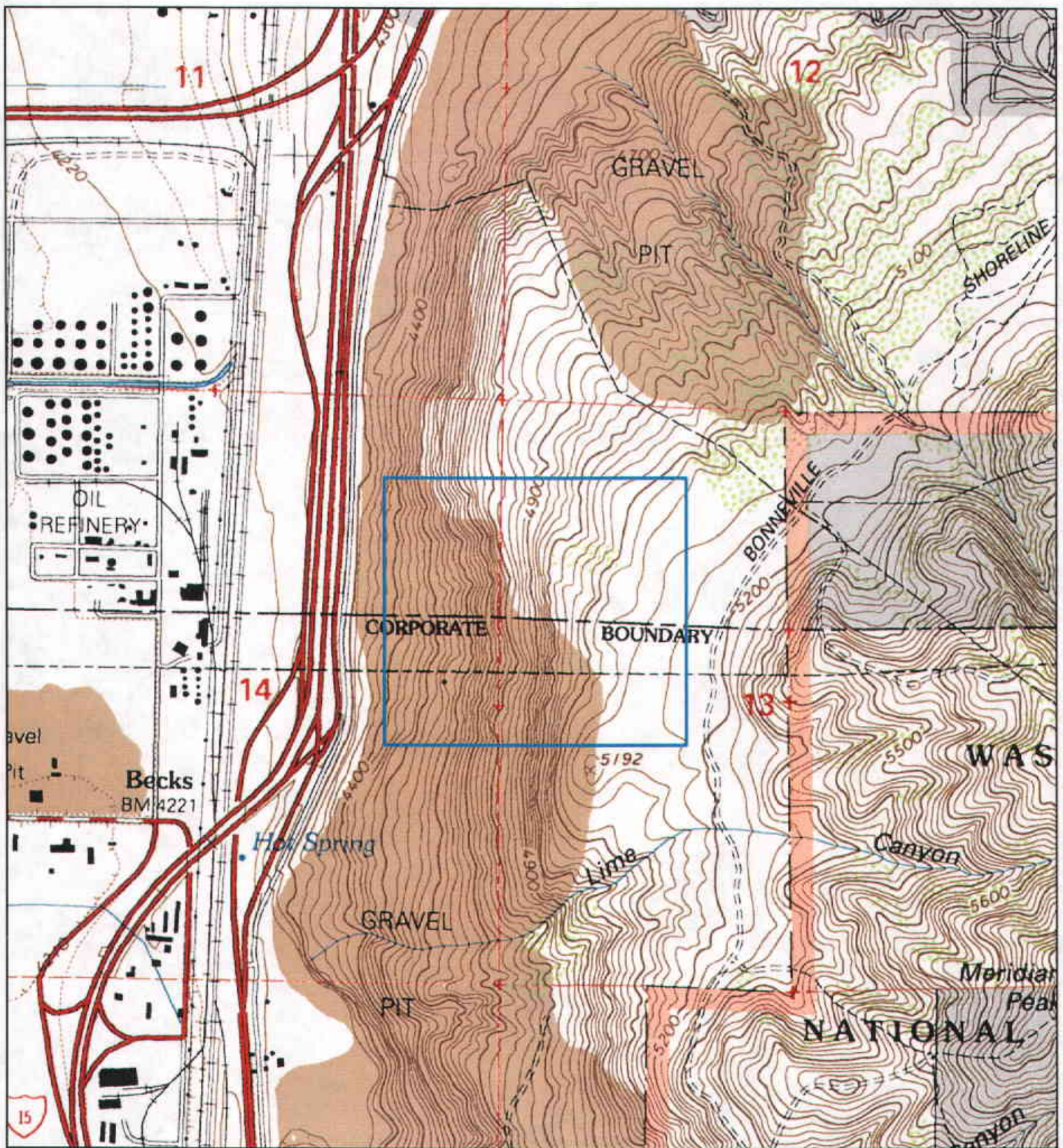
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Marinos, P and Hoek, E. 2000 GSI – A geologically friendly tool for rock mass strength estimation. *Proc. GeoEng2000 Conference*, Melbourne. 1422-1442.

Wyllie, Duncan C., Mah, Christopher W., Rock Slope Engineering, Civil and Mining, 4th Edition, 2004 Spon Press

Wallace, John F., Summary Report, Site Observations and Preliminary Engineering Analyses Staker Beck Street and Lakeview Reclamation Pit Slope, Intermountain GeoEnvironmental Services 2004.



BASE MAP:
USGS Topographic Map

0 500 1,000 2,000 3,000 4,000
Feet

Legend

Approx. Site Boundary

1:14,000

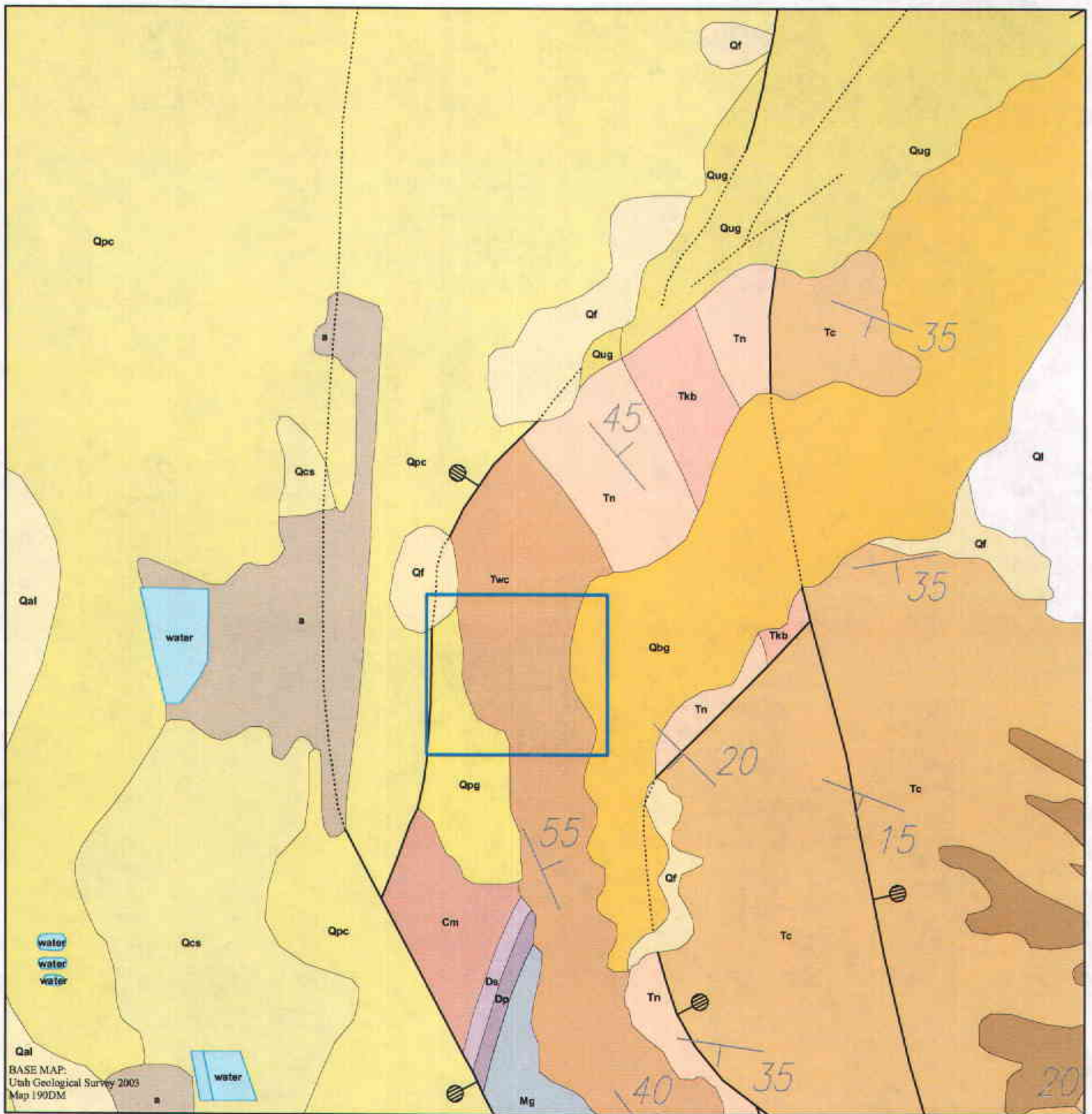


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**Plate
A-1**

Site Vicinity Map



Legend

Approx. Site Boundary

Approx. Site Boundary

Symbols

fault
strike and dip

Lines

— Contact, well located
— Fault, well located
..... Fault, concealed

Geology

Cm - Maxfield Limestone
Dp - Pinyon Peak Limestone
Ds - Stansbury Formation
Mg - Gardison Limestone
Qal - Alluvium

Qbg - Sand and gravel, high stand of Lake Bonneville
Qcs - Clay, silt, and sand
Qf - Alluvial-fan and debris-fan deposits
Qf - Landslide deposits
Qpc - Silt and clay, reg. phase of Lake Bonneville
Qpg - Sand and gravel, reg. phase of Lake Bonneville
Qug - Sand and gravel, high stand & reg. phase of Lake Bonneville, undivided
Tc - Conglomerate
Th - Hopper Canyon Formation
Tkb - Lahar, breccia, and tuff of Keetley Volcanics
Tn - Norwood Tuff
Twc - Conglomerate, Wasatch Formation
a - Artificial Fill
Water

0 1,000 2,000 4,000 6,000 8,000 Feet

1:24,001

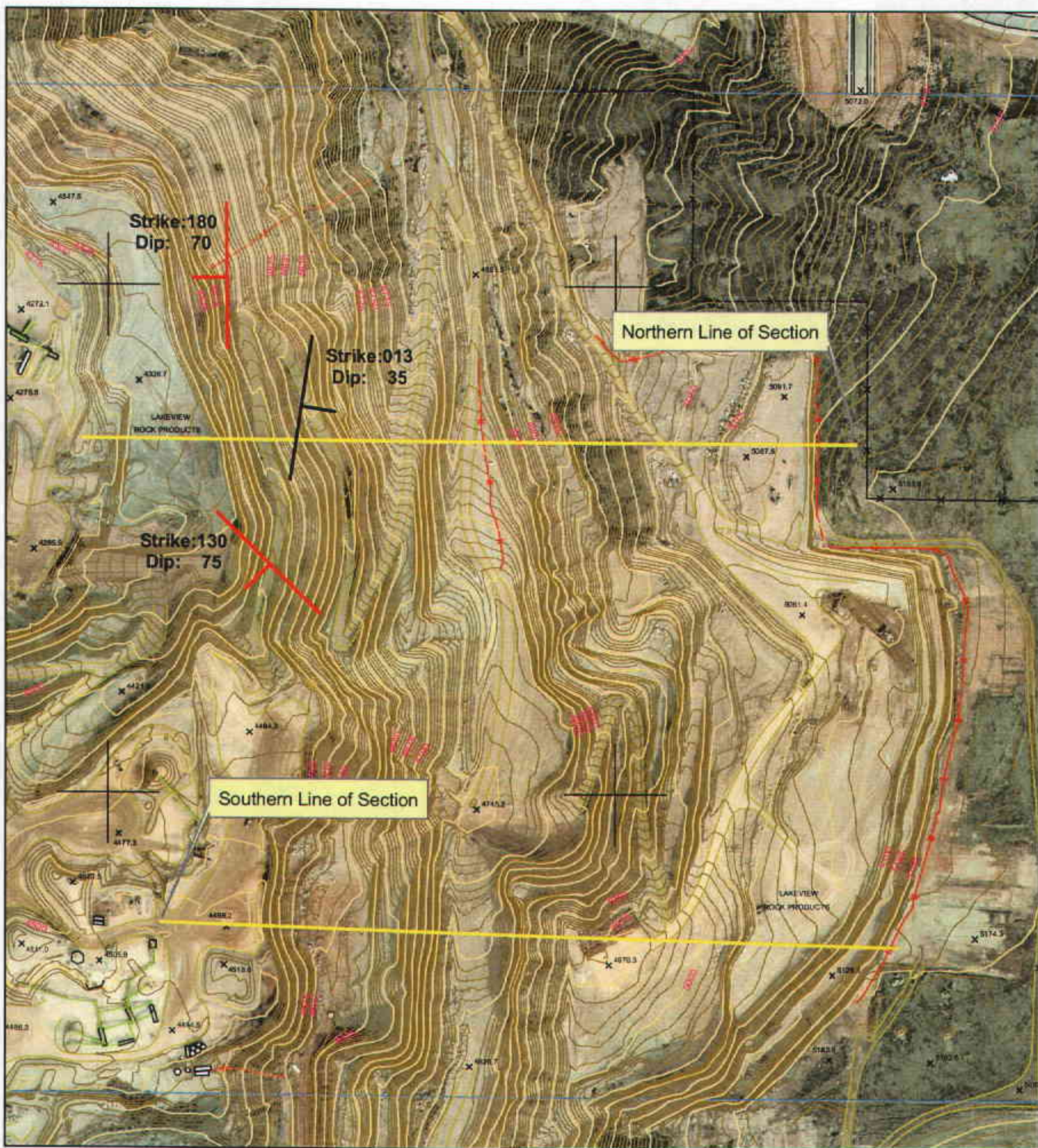


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Geologic Map

**Plate
A-2**



BASE MAP:
Client Provided Aerial Photography
and Topography

0 250 500 1,000

Legend

- Approx. Site Boundary
- Cross Section

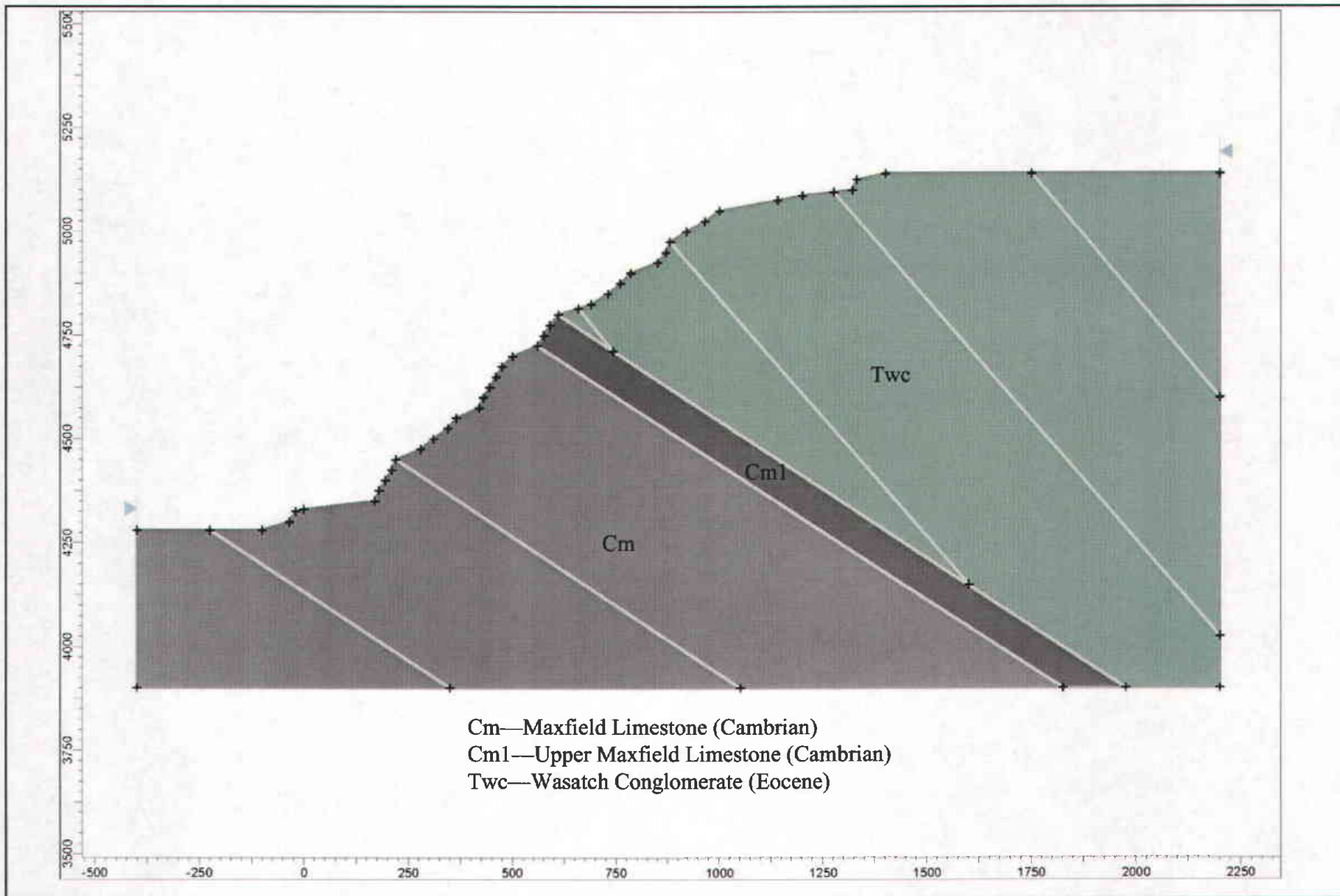


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**Slope Stability Cross
Sections Map**

**Plate
A-3**



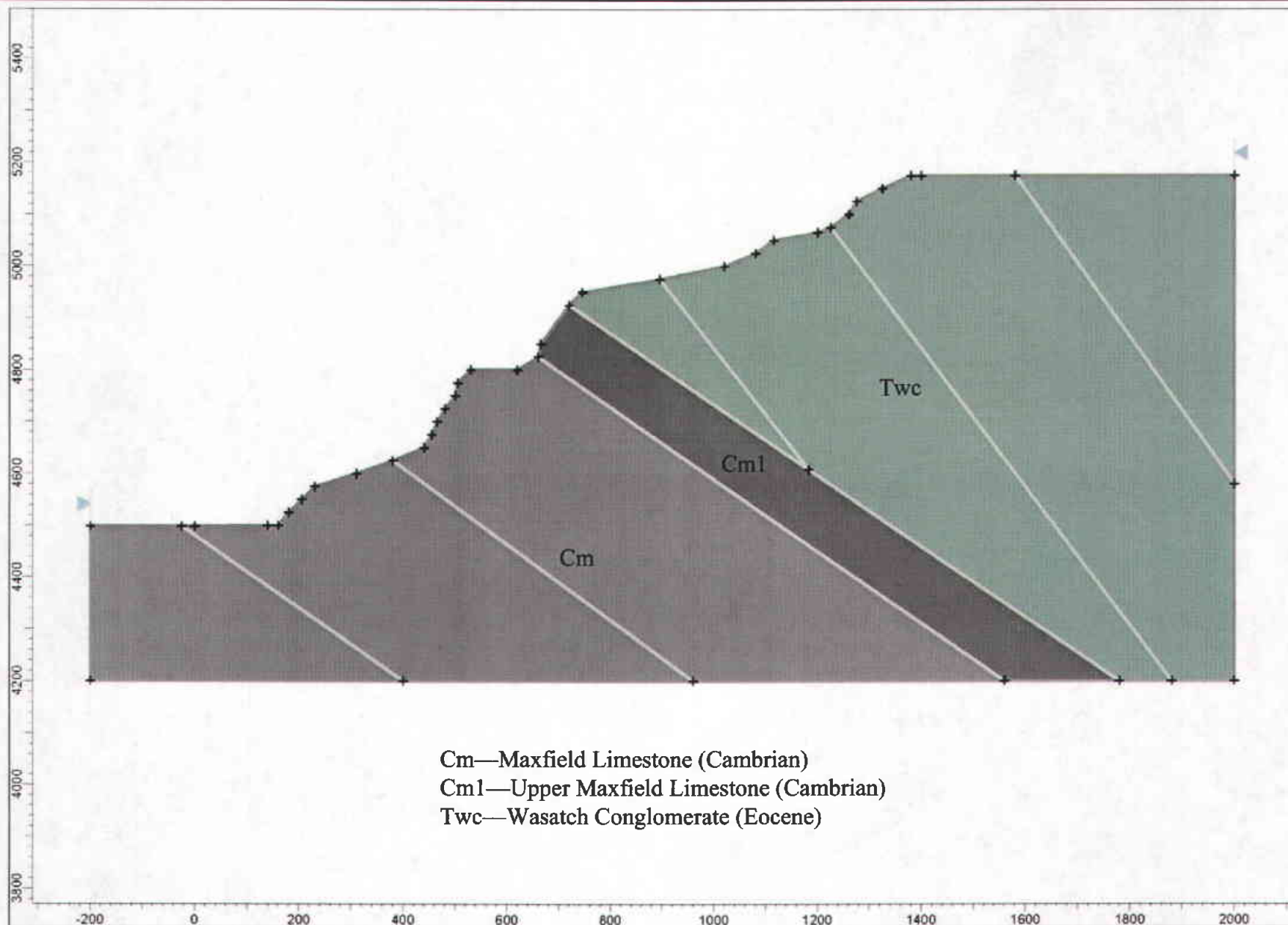
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NORTH CROSS SECTION

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**Plate
B-1**



Cm—Maxfield Limestone (Cambrian)
 Cm1—Upper Maxfield Limestone (Cambrian)
 Twc—Wasatch Conglomerate (Eocene)

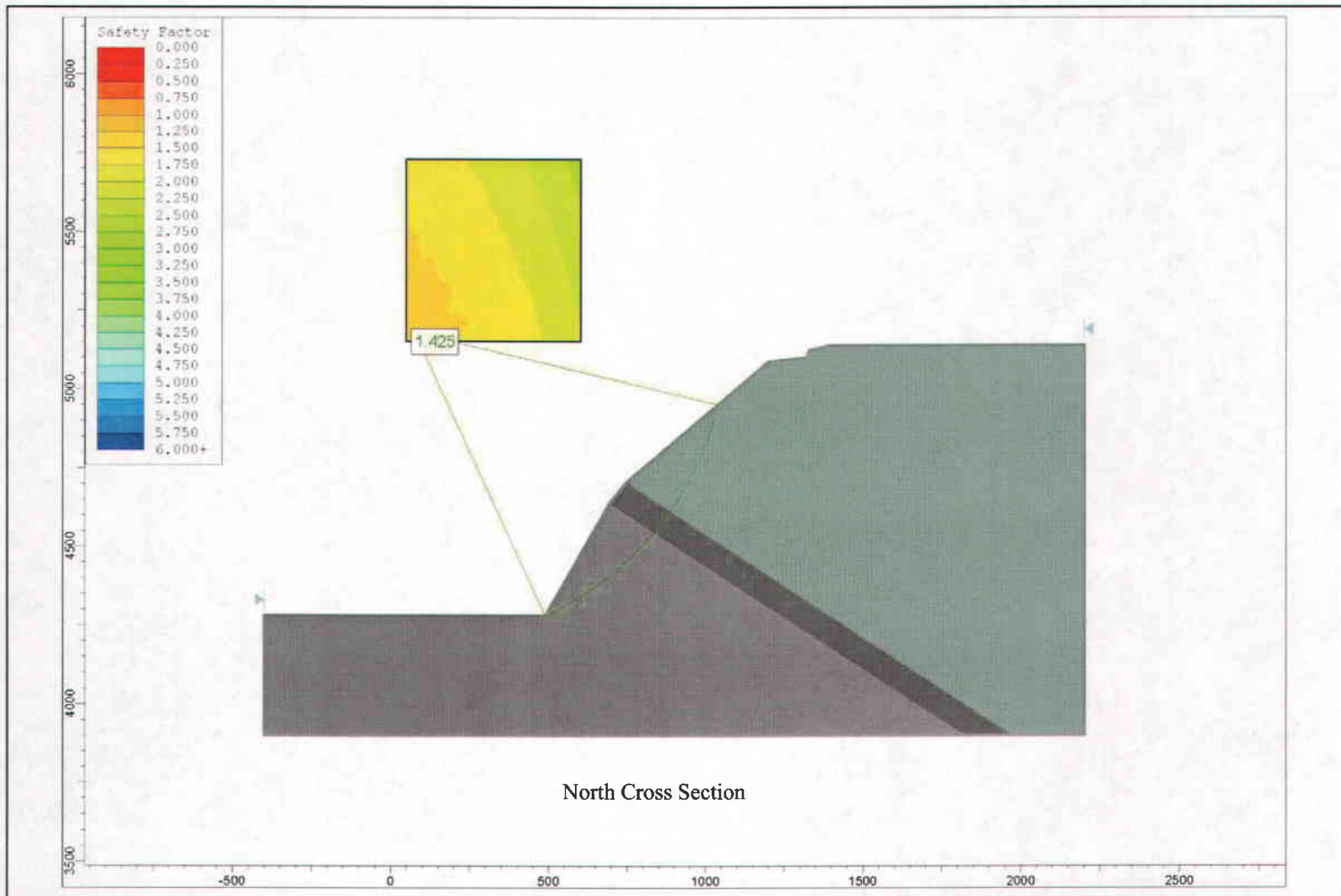
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SOUTH CROSS SECTION

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Plate
B-2



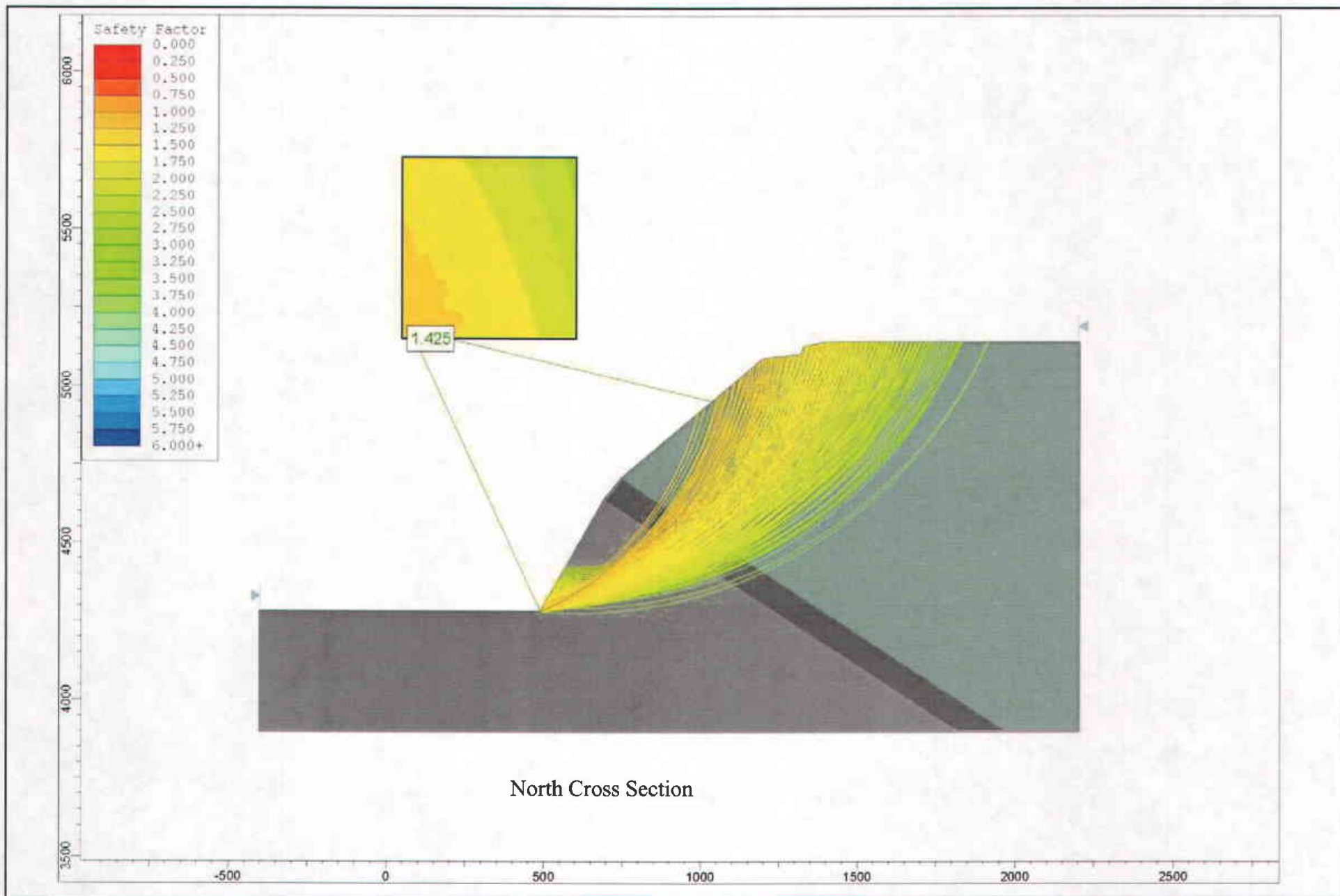
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GLOBAL MINIMUM

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**Plate
B-3**



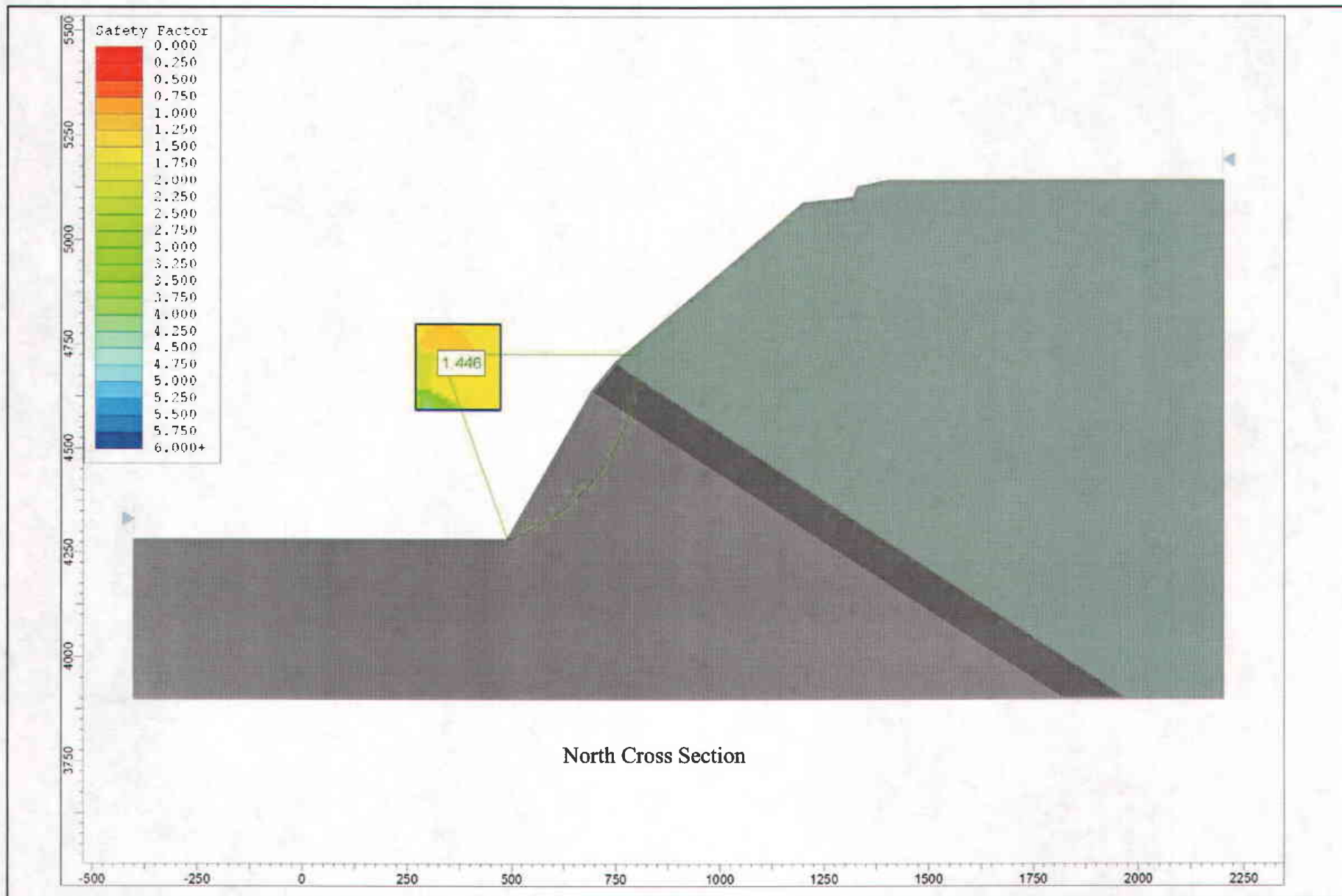
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GLOBAL SURFACES

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**Plate
B-4**



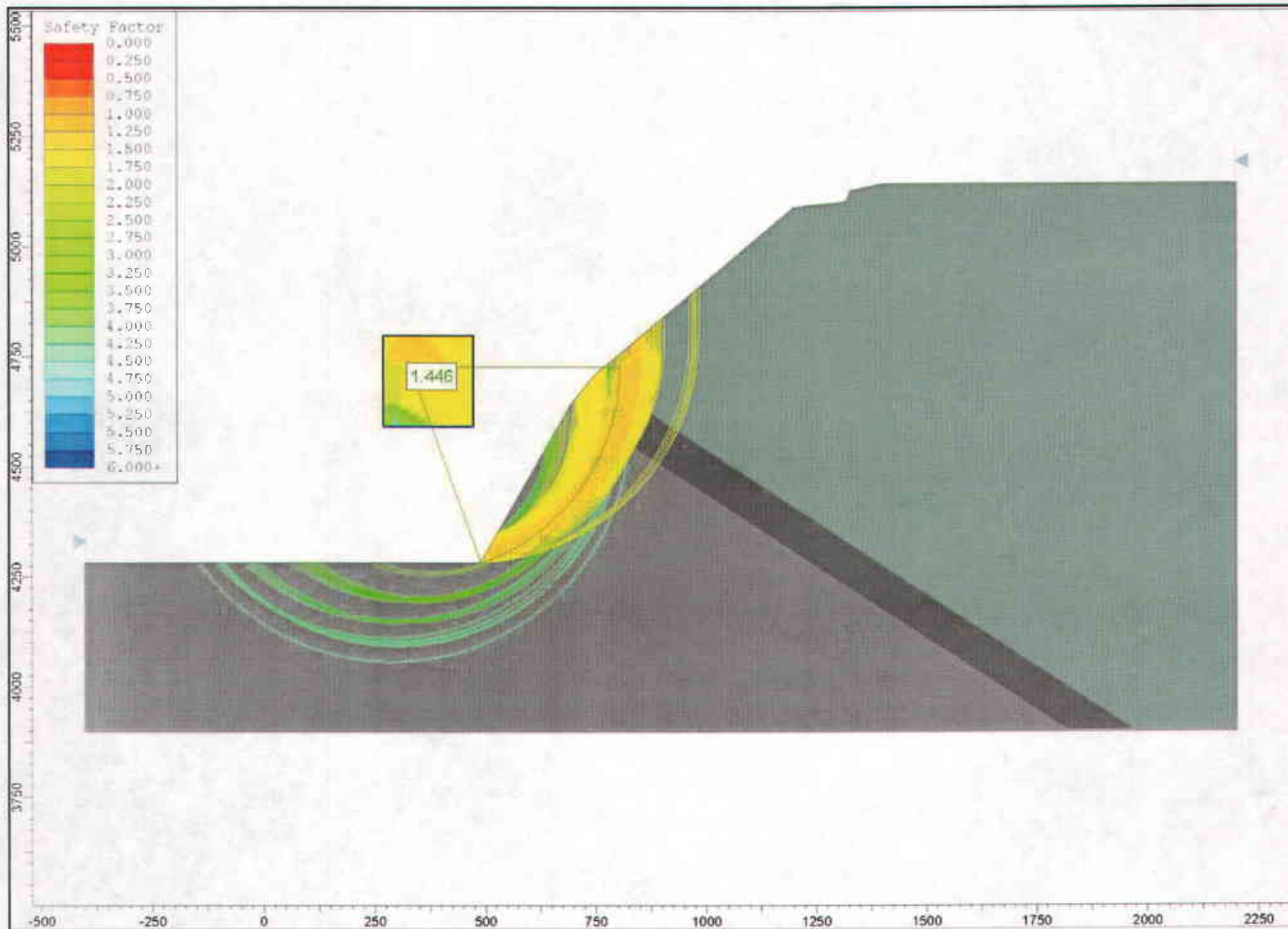
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BOTTOM MINIMUM

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**Plate
B-5**



North Cross Section

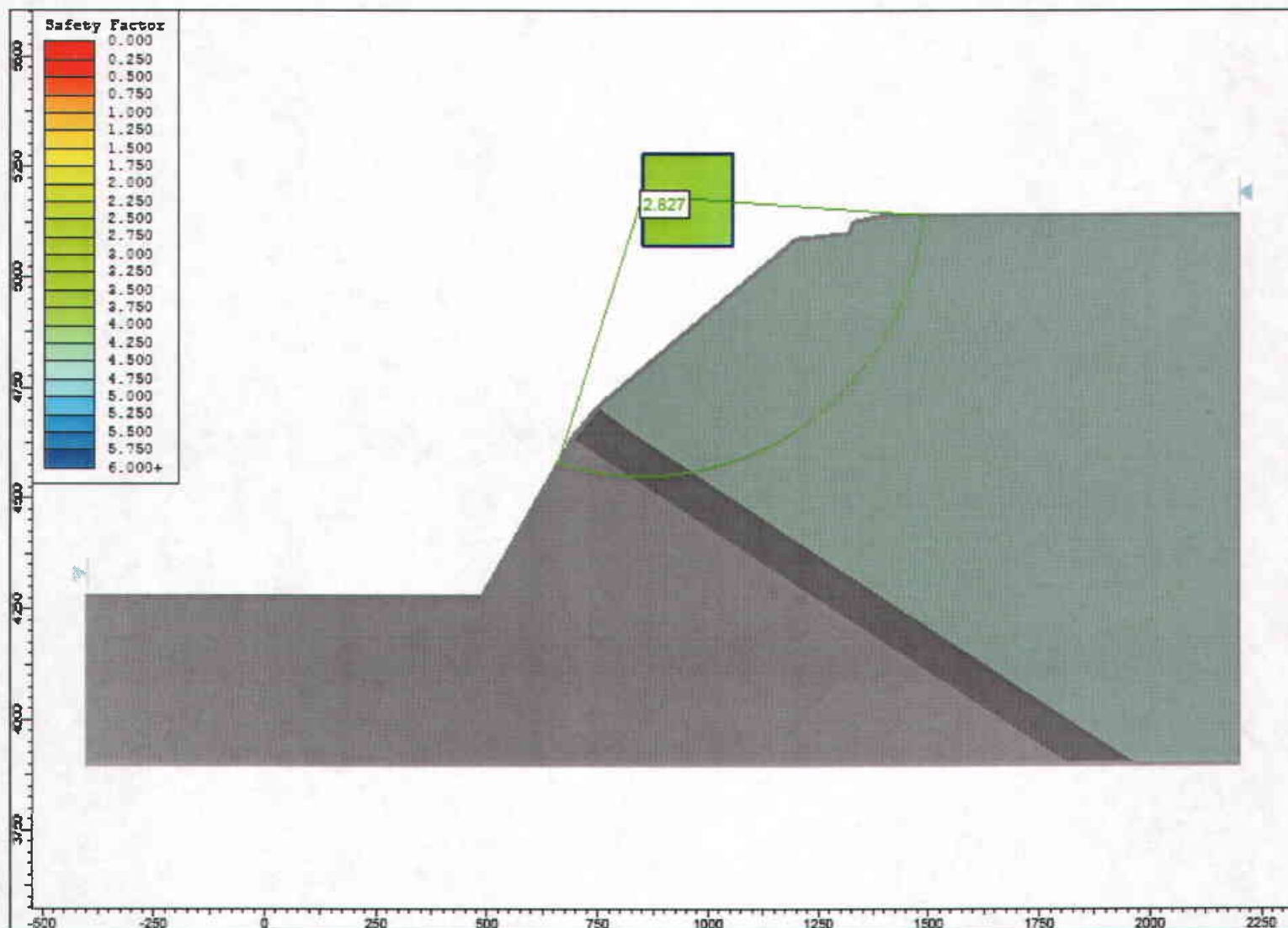
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Bottom Surface

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Project Number 609-001

**Plate
B-6**



North Cross Section

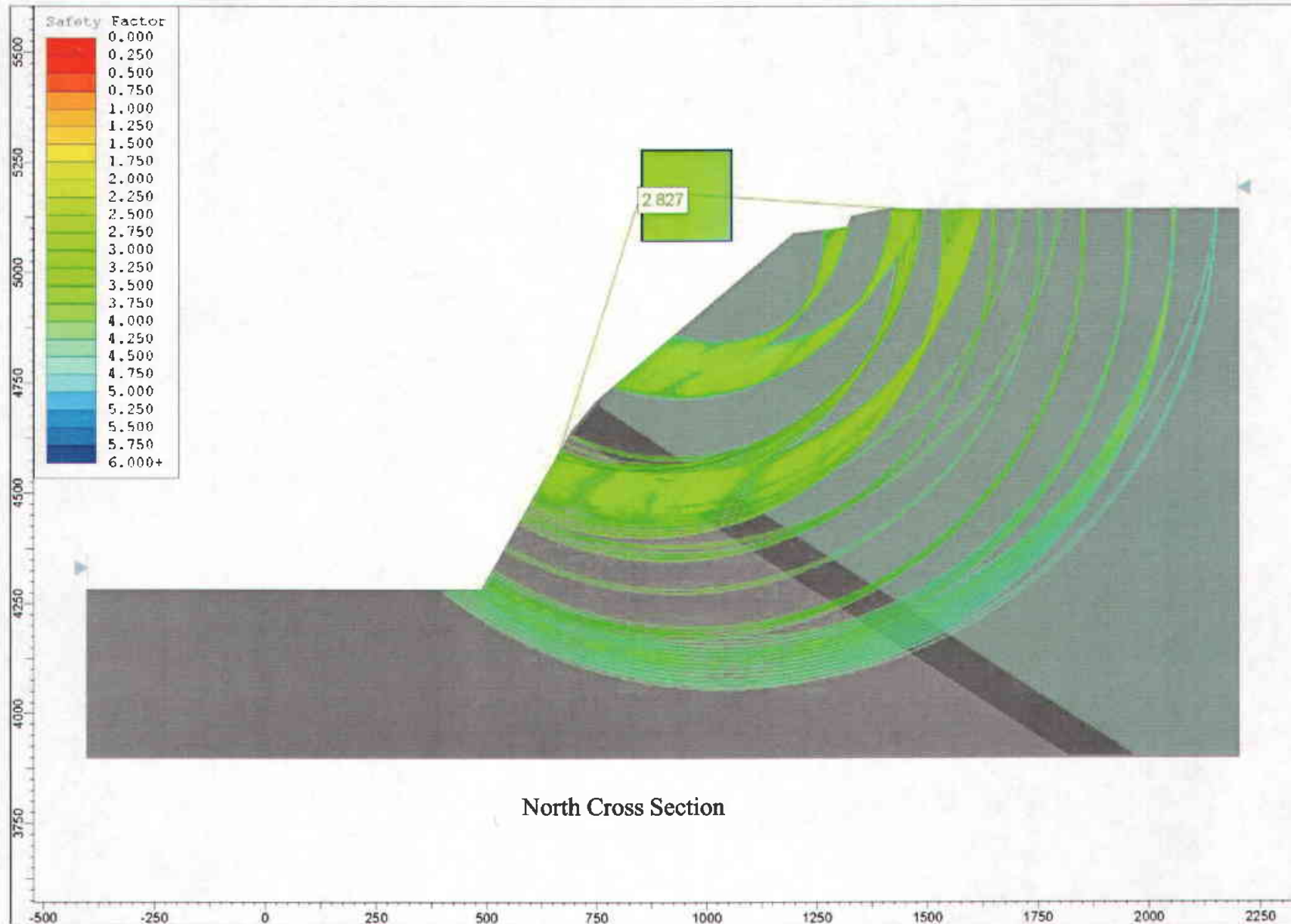
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Upper Minimum

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**Plate
B-7**



North Cross Section

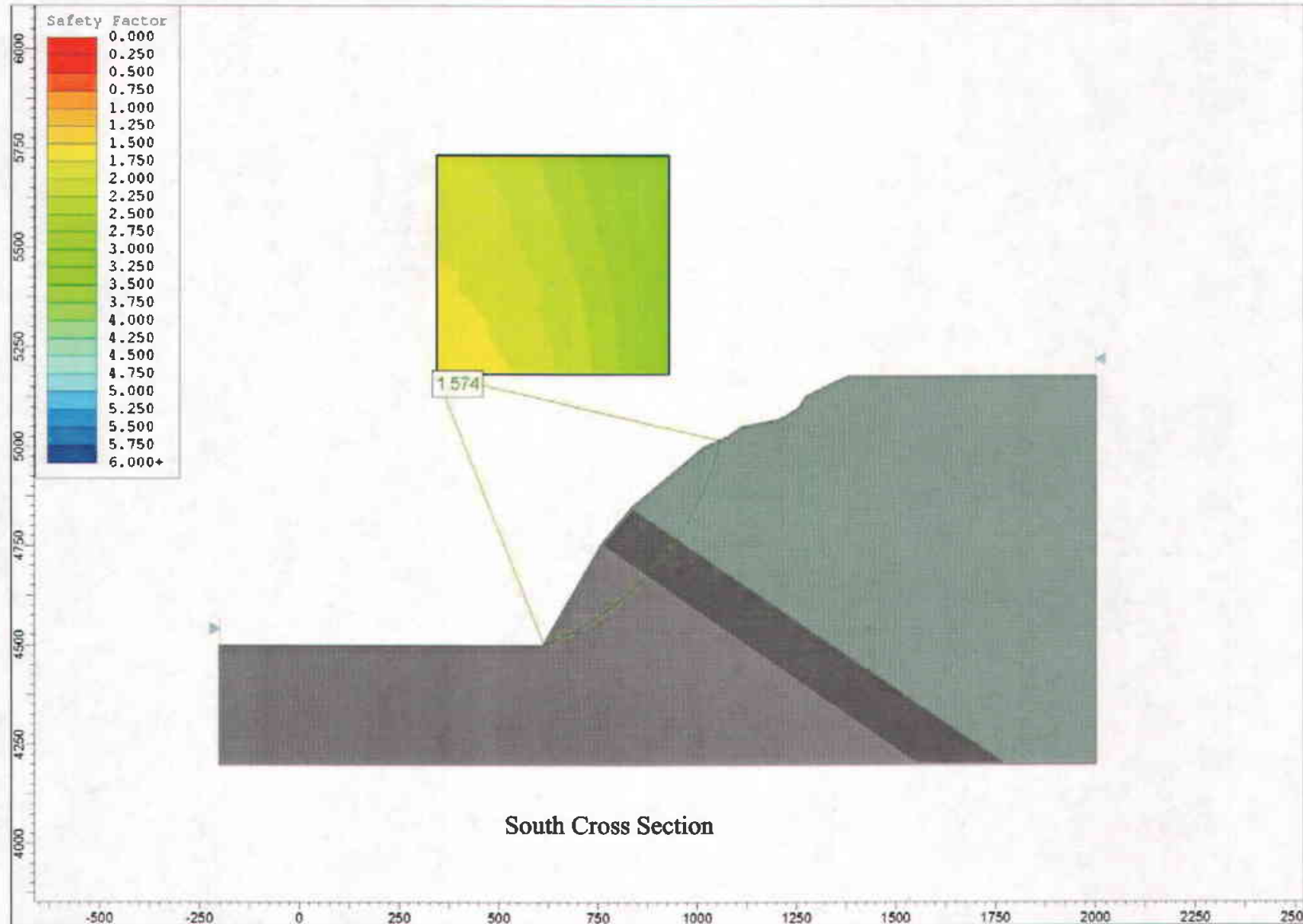
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Upper Surface

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**Plate
B-8**



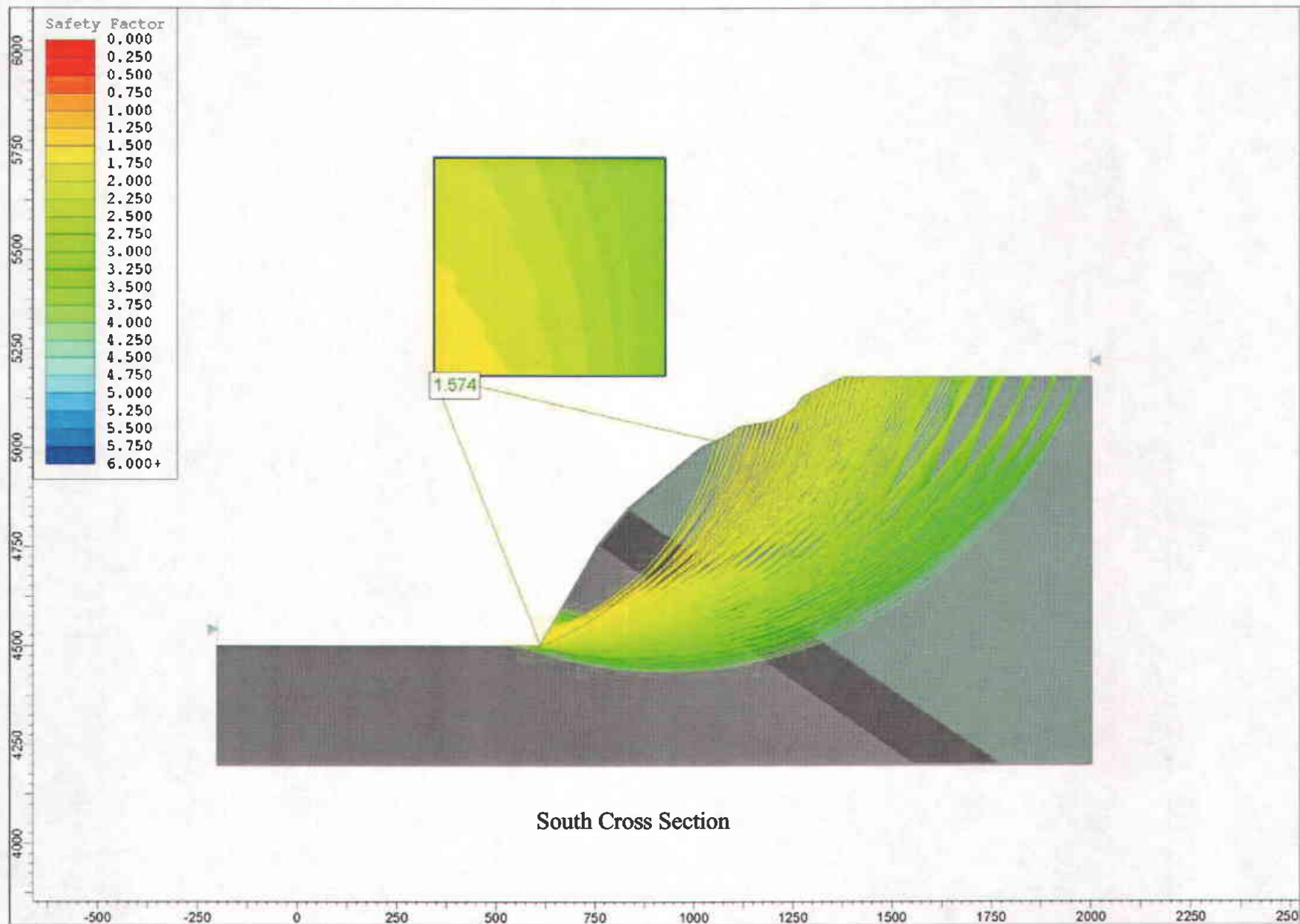
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**Plate
B-9**



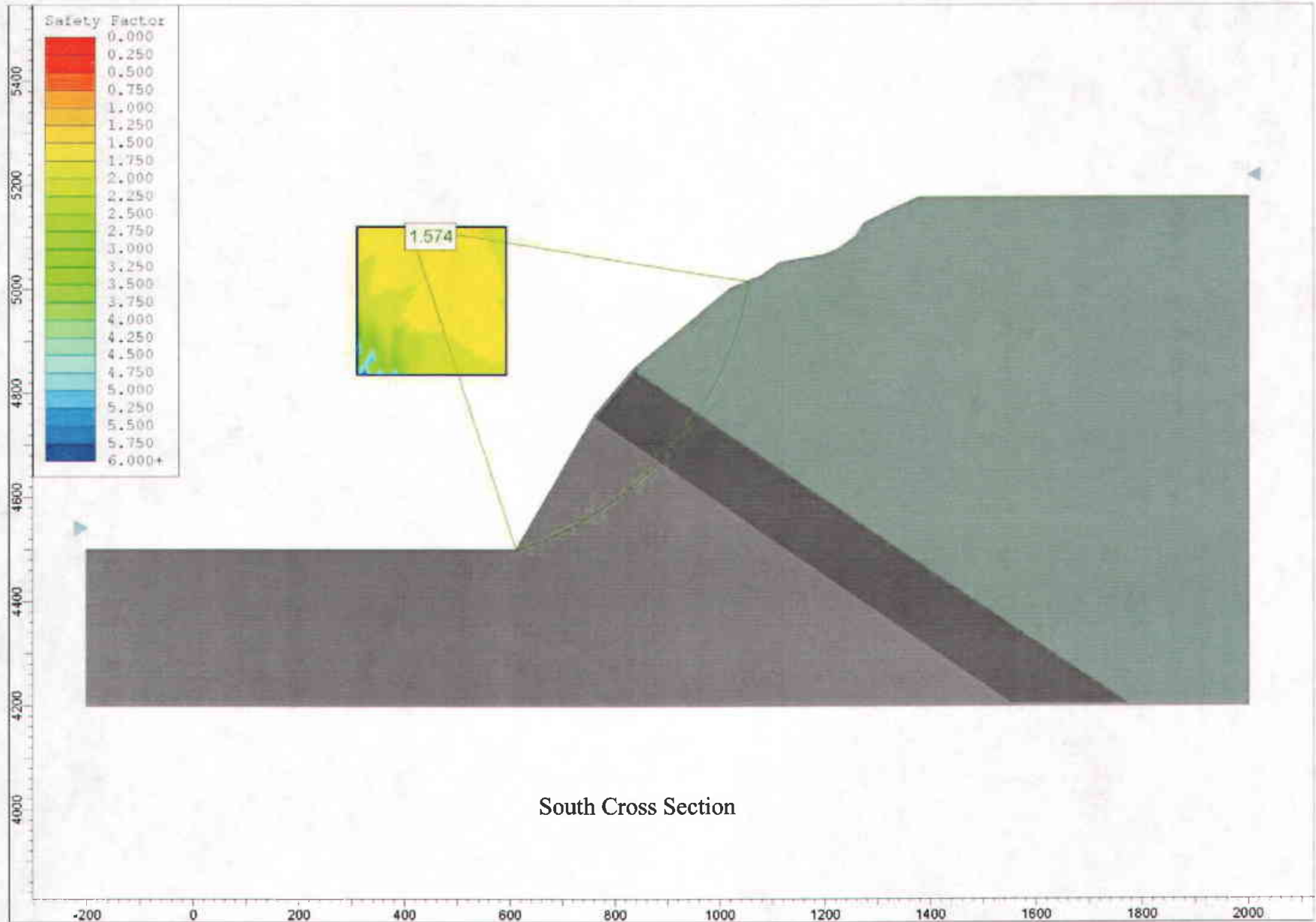
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**Plate
B-10**



South Cross Section

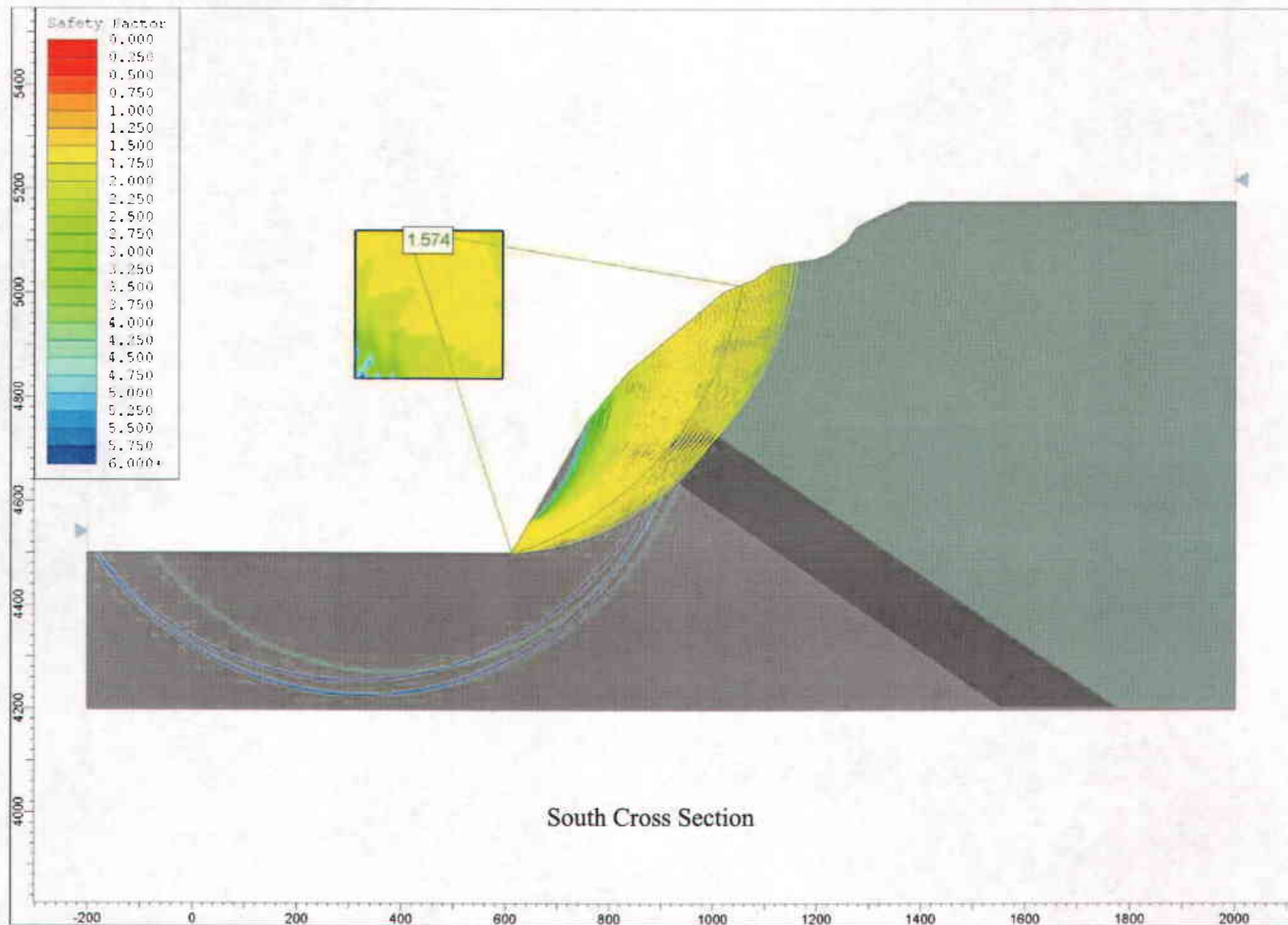
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**Plate
B-11**



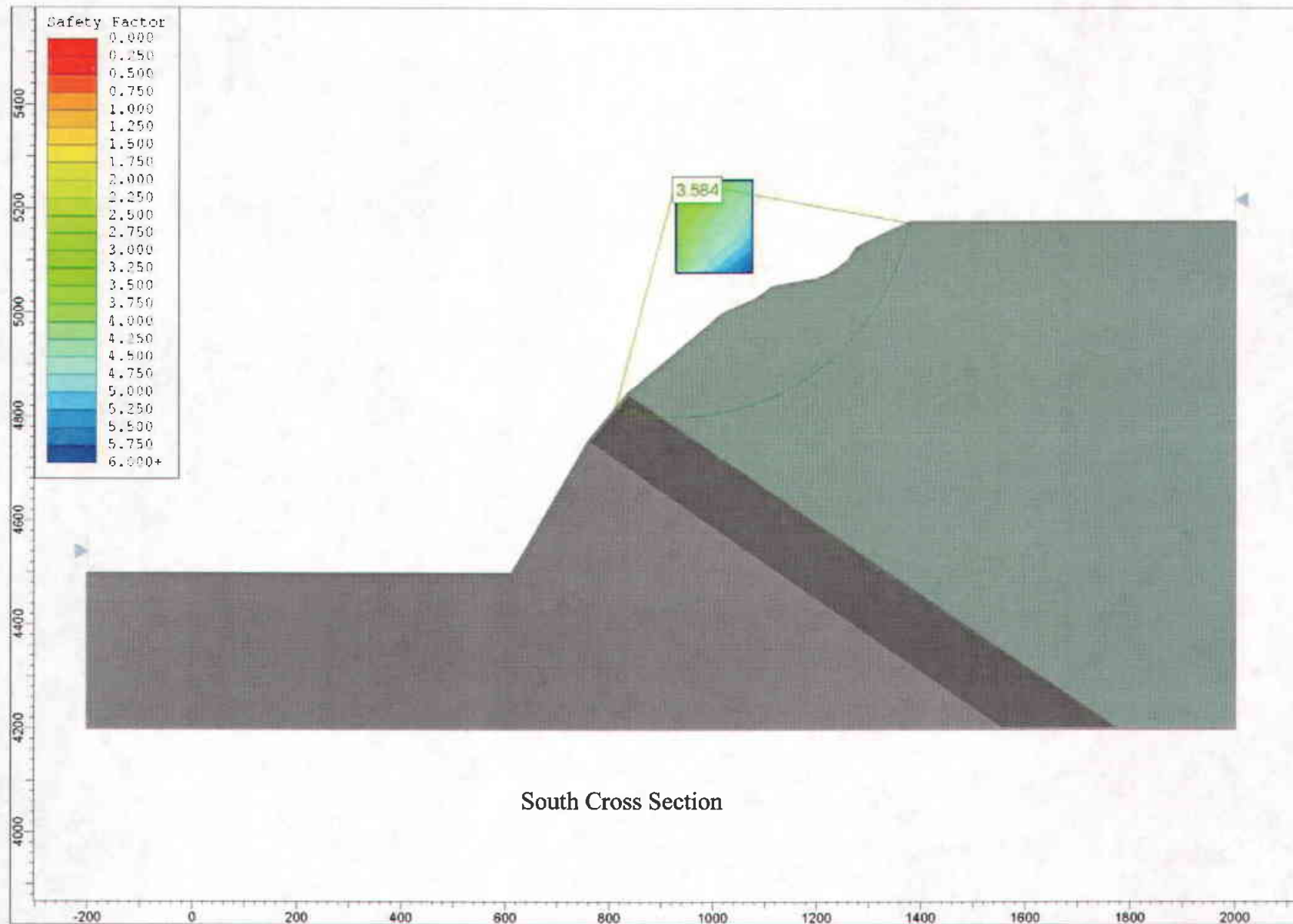
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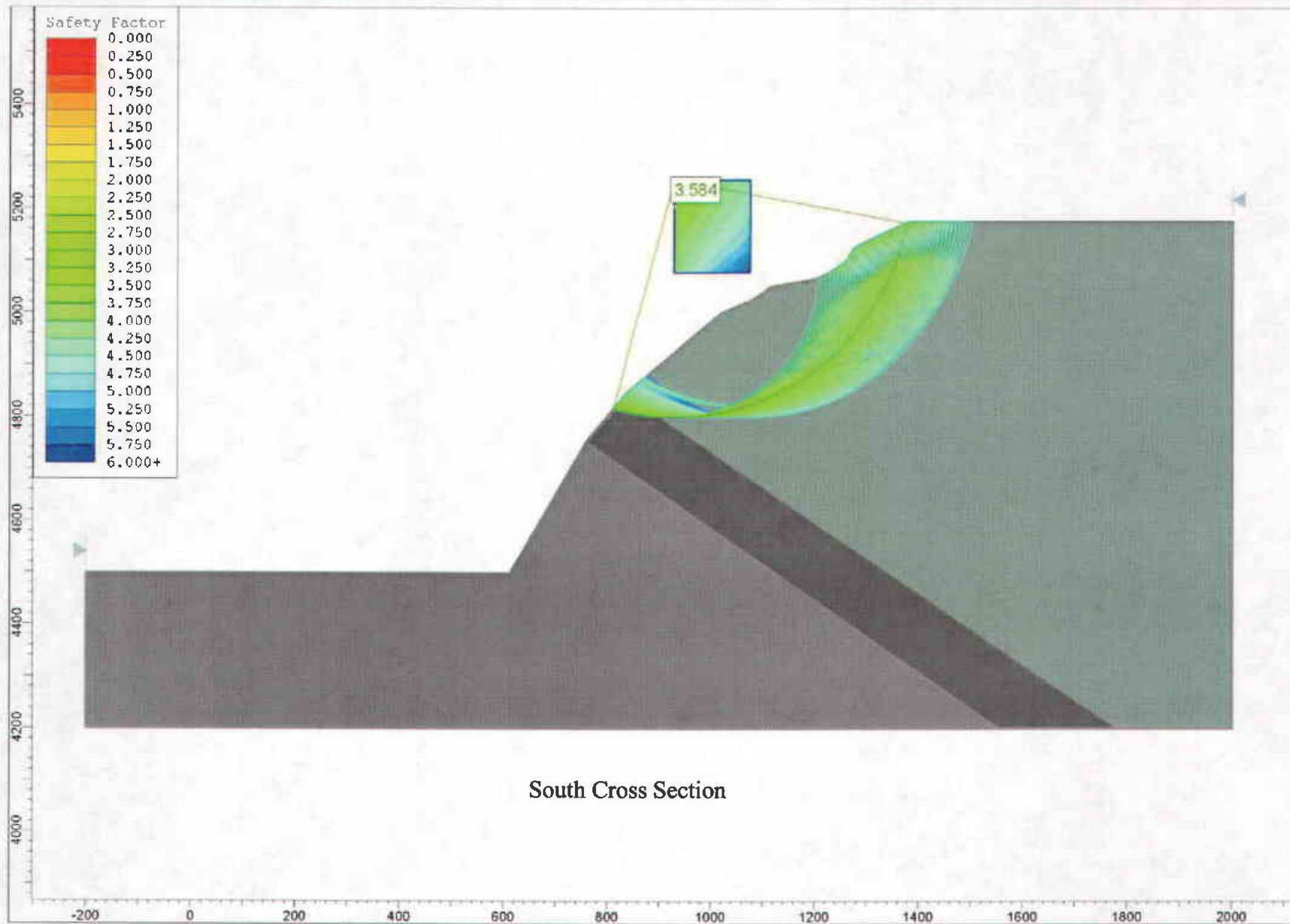
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Bottom Surface

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**Plate
B-12**





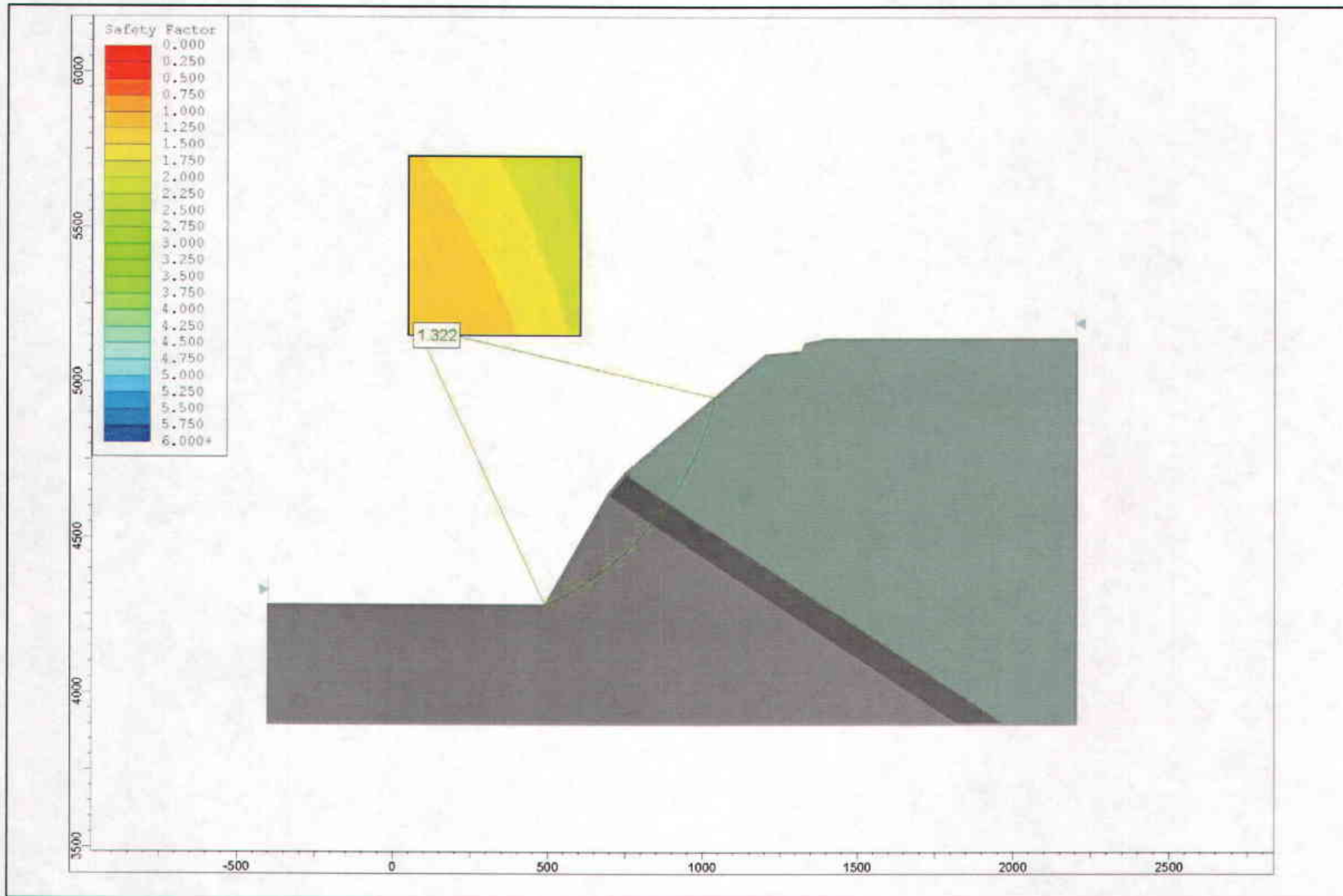
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Upper Surface

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**Plate
B-14**



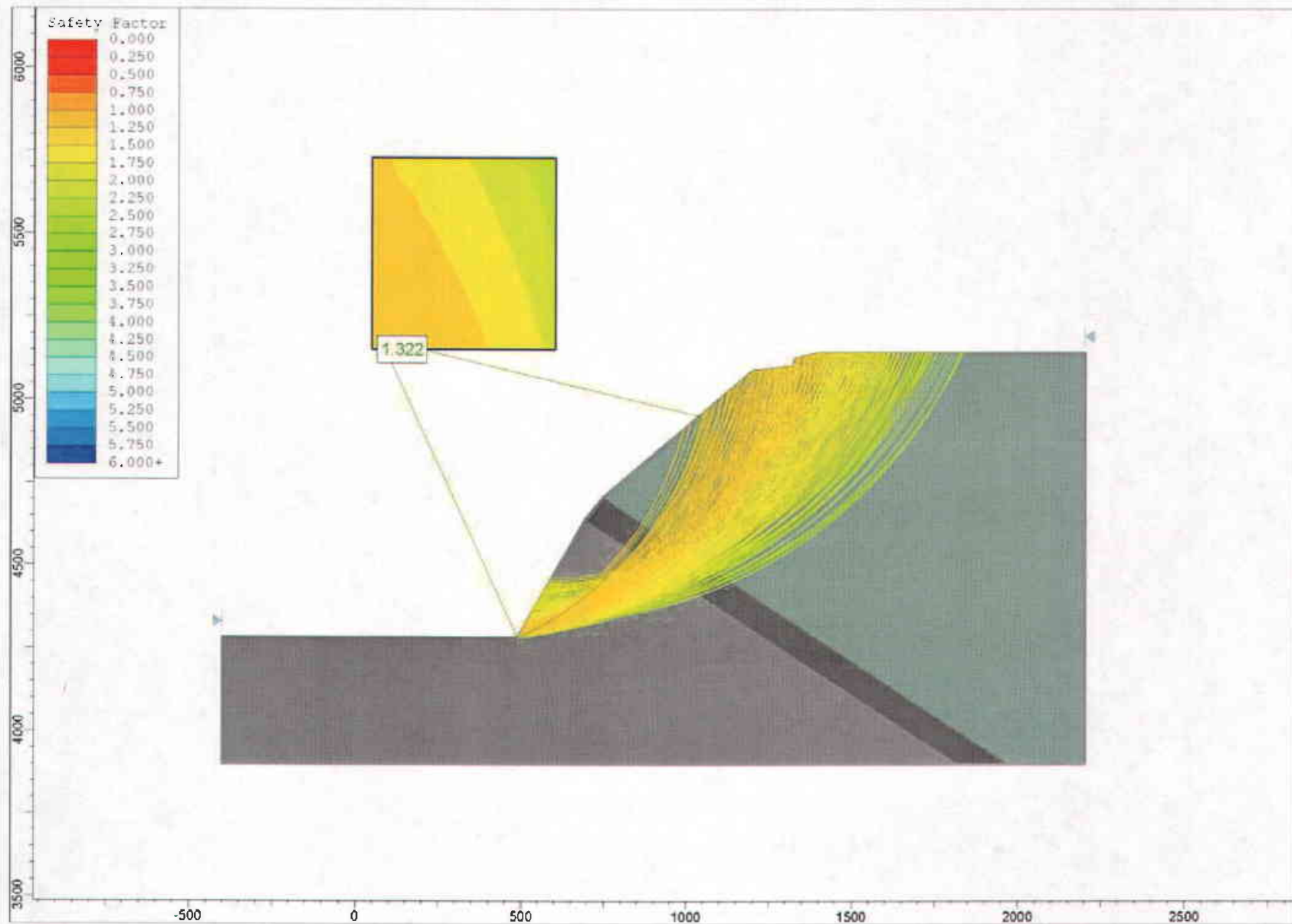
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Weak Siltstone Minimum

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**Plate
B-15**



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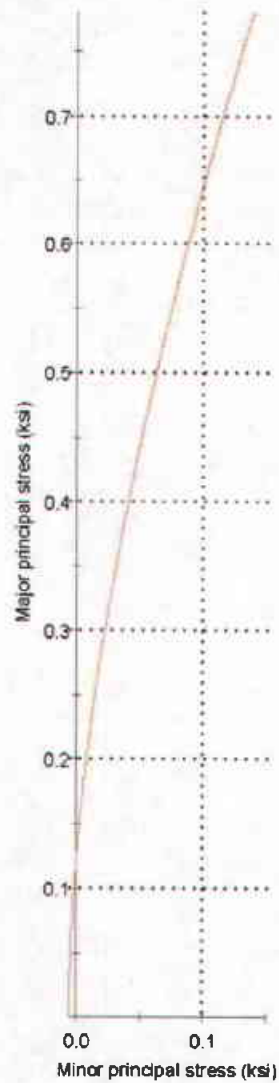
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Weak Siltstone Surface

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**Plate
B-16**

Analysis of Rock Strength using RocLab



Hoek-Brown Classification

intact uniaxial comp. strength (σ_{cd}) = 7 ksi
 GSI = 45 m_i = 9 Disturbance factor (D) = 0.7
 intact modulus (E_i) = 2800 ksi
 modulus ratio (MR) = 400

Hoek-Brown Criterion

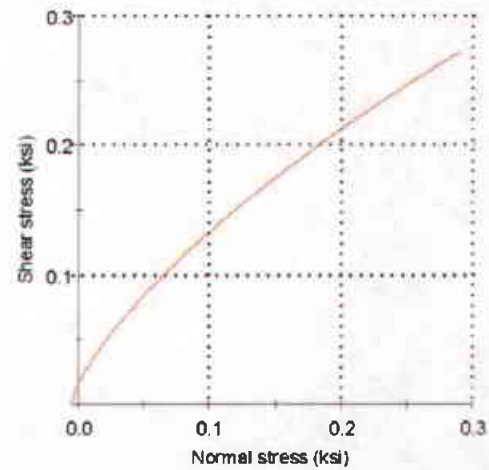
m_b = 0.438 s = 0.0003 a = 0.508

Mohr-Coulomb Fit

cohesion = 0.044 ksi friction angle = 39.87 deg

Rock Mass Parameters

tensile strength = -0.006 ksi
 uniaxial compressive strength = 0.122 ksi
 global strength = 0.599 ksi
 deformation modulus = 219.12 ksi



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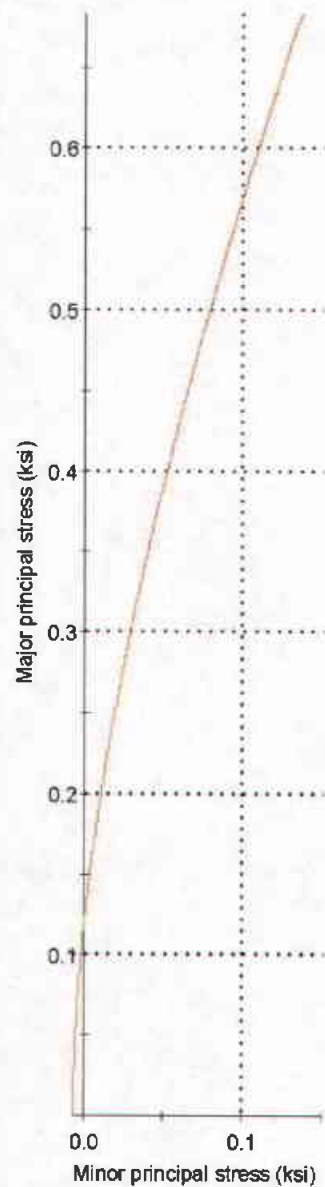
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Roclab Limestone

Lakeview Pit Slope Stability
 Herm Hughes Construction
 North Salt Lake, UT
 Project Number 609-001

**Plate
C-1**

Analysis of Rock Strength using RocLab



Hoek-Brown Classification

intact uniaxial comp. strength (σ_{ci}) = 6.6 ksi
 GSI = 45 m_i = 7 Disturbance factor (D) = 0.7
 intact modulus (Ei) = 2310 ksi
 modulus ratio (MR) = 350

Hoek-Brown Criterion

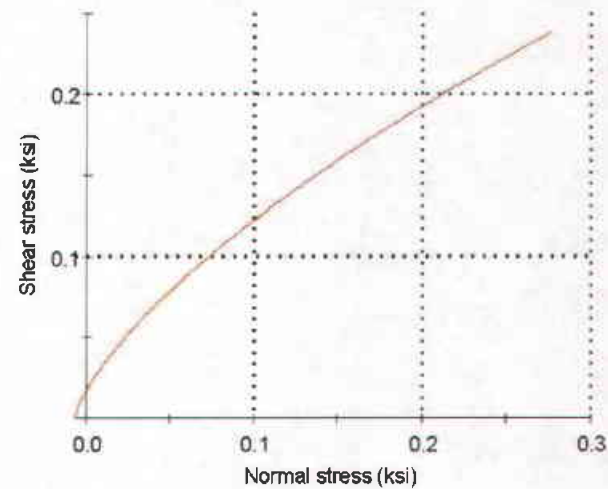
m_b = 0.341 s = 0.0003 a = 0.508

Mohr-Coulomb Fit

cohesion = 0.040 ksi friction angle = 37.24 deg

Rock Mass Parameters

tensile strength = -0.007 ksi
 uniaxial compressive strength = 0.115 ksi
 global strength = 0.498 ksi
 deformation modulus = 180.78 ksi



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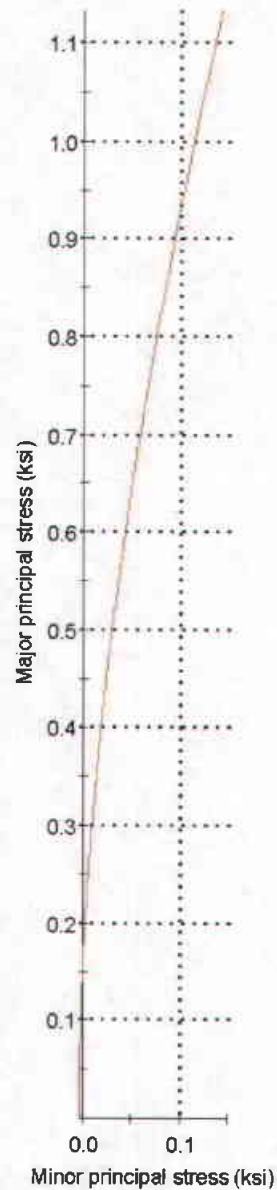
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Roclab Siltstone

Lakeview Pit Slope Stability
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 North Salt Lake, UT
 Project Number 609-001

**Plate
C-2**

Analysis of Rock Strength using RocLab



Hoek-Brown Classification

intact uniaxial comp. strength (σ_{ci}) = 6 ksi
 GSI = 50 m_i = 18 Disturbance factor (D) = 0.7
 intact modulus (E_i) = 1800 ksi
 modulus ratio (MR) = 300

Hoek-Brown Criterion

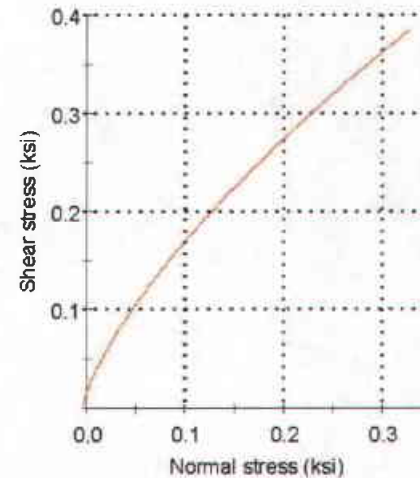
m_b = 1.154 s = 0.0007 a = 0.506

Mohr-Coulomb Fit

cohesion = 0.055 ksi friction angle = 46.87 deg

Rock Mass Parameters

tensile strength = -0.004 ksi
 uniaxial compressive strength = 0.154 ksi
 global strength = 0.846 ksi
 deformation modulus = 193.11 ksi



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Roclab Conglomerate

Lakeview Pit Slope Stability
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**Plate
C-3**